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Case #5218

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of: Ramesh Keshavaraj  
Serial Number: 09/828,081  
Filed: April 6, 2001  
For: **AIR BAG TETHER SYSTEM  
COMPRISING MULTIPLE SEGMENTS  
CUT IN ALIGNMENT WITH FABRIC  
WARP OR FILL**  
Group Art Unit: 1774  
Examiner: Unknown

**RESPONSE TO NOTICE OF INCOMPLETE REPLY (NONPROVISIONAL)**

Honorable Commissioner for Patents  
Washington, D. C. 20231

Sir:

In response to the Notice of Incomplete Reply for Serial No. 09/828,081, filing date April 6, 2001, attached is a copy of the Notice and a substitute specification having proper margins in compliance with 37 CFR 1.52. No other changes have been made to the specification and no new matter has been added.

Respectfully requested,

July 17, 2001

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**CERTIFICATE OF MAILING**

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to The Commissioner for Patents, Washington, DC 20231, on July 17, 2001, along with a substitute specification containing 8 pages of specification, 4 pages of claims, a one page abstract and a postcard receipt.

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## UNITED STATES PATENT AND TRADEMARK OFFICE

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## FORMALITIES LETTER



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Date Mailed: 07/09/2001

## NOTICE OF INCOMPLETE REPLY (NONPROVISIONAL)

*Filing Date Granted*

The U.S. Patent and Trademark Office has received your reply on to the Notice mailed and it has been entered into the nonprovisional application. The reply, however, does not include the following items required in the Notice.

The period of reply remains as set forth in the Notice. You may, however, obtain EXTENSIONS OF TIME under the provisions of 37 CFR 1.136 (a) accompanied by the appropriate fee (37 CFR 1.17(a)).

A complete reply must be timely filed to prevent ABANDONMENT of the above-identified application.

- A substitute specification in compliance with 37 CFR 1.52 because:
  - Papers contain improper margins. *Each sheet must have a left margin of at least 2.5 cm (1") and top, bottom and right margins of at least 2.0 cm (3/4")*

*A copy of this notice **MUST** be returned with the reply.*

  
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Initial Patent Examination Division (703) 308-1202

PART 2 - COPY TO BE RETURNED WITH RESPONSE

**AIR BAG TETHER SYSTEM  
COMPRISING MULTIPLE SEGMENTS CUT IN ALIGNMENT  
WITH FABRIC WARP OR FILL**

**5 TECHNICAL FIELD**

This disclosure relates to air bag tethers and to a pattern-wise arrangement of tether components in relation to air bag panels on a fabric blank, thus resulting in increased fabric utilization and an overall cost savings per finished air bag. The air bag tether system as described herein is comprised of two congruent multi-segment tether panels that are joined to one another and to a respective air bag panel. Unlike conventional tether systems, the segments that comprise the tether panels are cut in alignment with the warp and the fill of the fabric blank. This multi-segment construction, with its segments cut along the primary load-bearing axis of the fabric, decreases the amount of fabric that is used in the manufacture of the air bag and tethers, while providing sufficient elongation for the tether system to be functional.

**BACKGROUND**

Traditionally, air bag tethers have been used to control the excursion of an air bag as it inflates. As gas is released, causing the air bag to rapidly inflate, it is necessary to keep such inflation from occurring in an uncontrolled manner. Tethers, which are sewn to the front and rear panels of an air bag, keep the inflating air bag from expanding so rapidly as to adversely affect the safety of the vehicle occupant, as the vehicle occupant contacts the air bag.

Tethers are conventionally strip-shaped pieces of fabric that are aligned in pattern-wise arrangement on a fabric blank, or that are aligned in relation to air bag panels that may

be cut from the same blank. The patterns for these tethers may include a circular portion in the center area of the tether strip around which the strip is attached to the air bag panel. This circular portion makes it difficult to efficiently nest a number of tethers with one another on a fabric blank.

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It is understood in the industry that such tethers should have a capacity for elongation (that is, the tethers should be able to stretch to accommodate the rapid excursion of the bag). For this reason, conventional tethers have been cut on the bias with respect to the warp and fill of the fabric. However, aligning the tether patterns to meet the criterion of bias-cutting increases the amount of fabric needed to create an appropriate number of tethers for a plurality of air bags. Furthermore, because fabric utilization comprises more than fifty percent of the costs of a finished air bag, aligning the tethers in this manner increases production costs.

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## **SUMMARY**

The present air bag tether system addresses the problems of fabric utilization and tether elongation. Instead of the tether panels being cut on the bias, the tether panels are cut in alignment with the primary load-bearing axis of the fabric (i.e., the warp or the fill). Using a multi-segment tether system in which none of the tether panels are cut on the bias increases fabric utilization by allowing the tether segments to be arranged around air bag panels into spaces that would otherwise be considered fabric waste. The utilization of alignment-cut tether segments leads to improved fabric utilization, while providing a tether system that is capable of sustaining the forces exerted by the inflating air bag.

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## BRIEF DESCRIPTION OF THE DRAWINGS

**FIGURE 1** shows a side view of an air bag comprised of a front bag panel and a rear bag panel;

5     **FIGURE 2** shows a cross-sectional view of the air bag of **FIG. 1**, revealing a tether system incorporated therein;

**FIGURE 3A** shows a plan view of one tether segment of the present invention that is cut in alignment with the warp and fill of a fabric blank;

10     **FIGURE 3B** shows a plan view of a circular reinforcement as may be included in the air bag tether system of the present invention;

15     **FIGURE 3C** shows a plan view of a multi-segment tether panel, as comprised of two of the tether segments of **FIG. 3A** and the circular reinforcement of **FIG. 3B**, which would be attached to both the face and rear bag panels of the air bag of **FIG. 1**;

20     **FIGURE 3D** shows a plan view of a multi-segment tether, in which two of the tether segments of **FIG. 3A** are attached to either the face or rear panel of an air bag by a circular seam, but without the inclusion of the circular reinforcement of **FIG. 3B**;

**FIGURE 4** shows a plan view of a multi-segment tether that is comprised of three of the tether segments of **FIG. 3A** and the circular reinforcement of **FIG. 3B**;

25     **FIGURE 5** shows a plan view of a multi-segment tether that is comprised of four of the tether segments of **FIG. 3A** and the circular reinforcement of **FIG. 3B**; and

**FIGURE 6** shows a plan view of the arrangement of air bag panel components and the tether components of **FIGS. 3A** and **3B** on a fabric blank, in accordance with the teachings herein.

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#### **DETAILED DESCRIPTION**

In order to describe the invention, it is necessary that certain terms be defined. The term “bias” is intended to refer to a cut diagonally across the weave of a fabric, usually at an angle of 25 to 65 degrees with respect to the warp and fill. The term “substantial alignment” shall be used to describe a cut made at an angle less than 25 degrees from the warp or fill of the fabric, and, more preferably, in direct alignment with the warp or fill of the fabric.

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The term “tether segment” is used to describe a unit of fabric having a length greater than its width, and, more preferably, a substantially rectangular piece of fabric, that is used in the creation of a tether panel. For simplicity, a rectangle will be used in the drawings to represent these segments. The present invention relates to tether segments that are cut in substantially alignment with either the warp or fill of the fabric. The term “tether panel” shall refer to one of two components of a tether system; each of the tether panels is comprised of two or more tether segments positioned on the same bag panel, either with or without a central reinforcement, as will be described herein. The term “tether system” shall refer to joined tether panels utilized to prevent the uncontrolled excursion of an inflating air bag from adversely affecting a vehicle occupant with whom such a bag comes into contact. Tether systems generally employ two tether panels for each finished air bag, and, as shall be described herein, each tether panel of the present invention comprises two to four tether segments.

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The term “front” shall refer to that portion of an air bag that is nearest a vehicle occupant, while the term “rear” shall refer to those portions of an air bag that are furthest from the vehicle occupant (e.g., in the case of front-seat air bags, nearest the windshield). The term “bag panel” shall be used to describe one of the fabric panels used to create a finished air bag. The term “central attachment region” shall refer to that area of the bag panel around which the tether segments are radially positioned. The axis of radial symmetry of the inflated air bag is located within the central attachment region.

Because of the speed with which an air bag inflates, it is necessary for the protection of vehicle occupants to control the volume of space that the air bag occupies in the vehicle cabin. Tethers accomplish this task by preventing the uncontrolled expansion of the air bag. Tethers are securely connected to the interior portions of the air bag, usually by sewing, welding, gluing, or other joining techniques.

**FIG. 1** shows a side view of an air bag **10**. Air bag **10** is comprised of a front bag panel **4** and a rear bag panel **6**, bag panels **4** and **6** being substantially circular, although other panel geometries could also be used. For example only, and not meant as limitation, bag panels **4** and **6** having the shape of a regular  $n$ -sided polygon could also be used. As is standard within the industry for this type of simple air bag, bag panels **4** and **6** should have the same geometry.

**FIG. 2** shows a cross-sectional view of air bag **10**, revealing the arrangement of a tether system therein. Tether segments **14** (shown in **FIG. 3A** as being cut in substantial alignment with the warp or fill of a fabric blank) are attached to front bag panel **4** and rear bag panel **6**. The end of each tether segment **14** that is attached to a bag panel (**4** or **6**)

shall be known as the bag-attachment end. Tether segments **14** are shown in lapped fashion with one another in the interior of air bag **10**. The end of each tether segment **14** that is attached to another tether segment **14** shall be known as the tether-attachment end. The joining of tether segments **14** (at their respective tether-attachment ends) is shown as being achieved by means of seam **18**, but such joining may be accomplished by any other means, such as welding, gluing, or other attachment techniques. In one embodiment, tether segments **14** are substantially rectangular in shape, although any segments having a greater length than width may be used, including tether segments **14** with flared or arc-shaped bag-attachment ends.

In one embodiment, at least one central region reinforcement **12** (shown in **FIG. 3B**) is also attached to front bag panel **4**, as well as rear bag panel **6**. It is common for reinforcements, having a circular or other shape, to be used in the production of air bags **10**. One or more central region reinforcements **12** are included with tether segments **14** to form tether panel **24** (as shown in **Fig. 3C**). Such reinforcements **12** are particularly important in preventing tears around the mouth of air bag **10**, at the location of the inflation media. For that reason, up to five reinforcements **12** may be desirable for attachment to rear bag panel **6**. In other circumstances, such as when cool-temperature inflation media are used, no reinforcements **12** may be needed.

Tether segment **14** is part of a multi-segment tether panel **24** that is shown in **FIG. 3C**. In one embodiment, tether panel **24** is comprised of at least two of tether segments **14** and at least one central region reinforcement **12**. Central region reinforcement **12** is positioned in the central attachment region of bag panel **4**. Tether segments **14** are positioned radially about the central attachment region of bag panel **4** and are secured at their respective bag-attachment ends to reinforcement **12** and to bag panel **4** by seam



22, as indicated by a dotted line in **FIG. 3C**. Similarly, tether segments **14** and reinforcement **12** are attached to rear bag panel **6**. The tether-attachment ends of tether segments **14** attached to front bag panel **4** are joined to the tether-attachment ends of tether segments **14** that are attached to rear bag panel **6** by seaming, welding, gluing, or  
5 other attachment means as are known in the art.

**FIG. 3D** shows a variation of tether panel **24**. In this embodiment, central region reinforcement **12** is omitted. Tether segments **14** are positioned radially about the central attachment region of bag panel **4** or **6** and are then attached to bag panel **4** or **6**  
10 by means of seam **22**. As described previously, other attachment means including welding or gluing could also be employed. In this embodiment, although tether segments **14** do not directly contact one another, tether segments **14** nevertheless act in cooperation with one another and with bag panel **4** or **6** to which they are attached (not shown) to form tether panel **28**.

15 Turning now to **FIG. 4**, a three-legged tether panel **34** is shown. Three-legged tether panel **34** is comprised of three tether segments **14** and at least one central region reinforcement **12** that is positioned in the central attachment region of bag panel **4** or **6**. Tether segments **14** are positioned radially about the central attachment region of bag  
20 panel **4** or **6** and are secured at their respective bag-attachment ends to reinforcement **12** and to bag panel **4** or **6** by seam **22**. Three-legged tether panels **34** are useful for reducing bag oscillation during deployment.

**FIG. 5** shows a four-legged tether panel **44**. Four-legged tether panel **44** is comprised of  
25 at least one central region reinforcement **12** that is positioned in the central attachment region of bag panel **4** or **6** and four tether segments **14** positioned radially about the

central attachment region of bag panel **4** or **6**. Seam **22** secures tether segments **14** and reinforcement **12** to bag panel **4** or **6**, although other attachment means could also be used. Four-legged tether panels **44** are even more capable of reducing oscillation during bag deployment.

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**FIG. 6** illustrates an arrangement on a fabric blank **90** of air bag panels **4** and **6**, tether segments **14**, and central region reinforcements **12**. By way of example only, bag panels **4**, **6** having a circular shape are illustrated. The separation of the conventional tether into multiple tether segments **14** allows a greater number of air bag components to be produced from a smaller length of fabric, by nesting tether segments **14** between bag panels **4**, **6** into areas that would otherwise be considered fabric waste. Further, because the tether panels **14** are cut in substantial alignment with the warp or fill of fabric blank **90**, the amount of fabric utilized per finished air bag **10** and the amount of fabric waste is decreased significantly. This statement applies to tether panels **34** and **44** as well.

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The multi-segment tether system of the present invention includes a pair of tether panels **24** (or **28**, **34**, or **44**) whose individual tether segments **14** are cut in substantial alignment with the warp or fill of fabric blank **90**. Each tether panel **24** is comprised of multiple tether segments **14** and may or may not include central region reinforcements **12**. By incorporating these various multi-segment tether systems, the present invention addresses the issues of fabric utilization and cost, thus representing a useful advancement over the prior art.

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I claim:

1. A tether panel to be used in a tether system of an air bag, said tether panel comprising at least two tether segments cut from a textile fabric, said fabric constructed of a group of warp yarns and a group of fill yarns, wherein each of  
5 said segments is cut in substantial alignment with one of said groups of yarns.
2. The tether panel of Claim 1 wherein said tether segments are substantially rectangular in shape.
- 10 3. The tether panel of Claim 1 wherein said tether panel is comprised of three of said tether segments.
4. The tether panel of Claim 1 wherein said tether panel is comprised of four of said tether segments.
- 15 5. The tether panel of Claim 1 wherein said tether panel is further comprised of a reinforcement, said reinforcement being positioned centrally between said tether segments.
- 20 6. A bag panel, said bag panel having an axis of radial symmetry, said axis of radial symmetry being located within a central attachment region of said bag panel, said bag panel further having at least two tether segments arranged radially about said central attachment region in a configuration having at least one axis of symmetry that is perpendicular to said axis of radial symmetry of said bag panel,  
25 wherein said tether segments are cut from a textile fabric, said textile fabric

constructed of a group of warp yarns and a group of fill yarns, said tether segments being cut in substantial alignment with one of said groups of yarns.

- 5 7. The bag panel of Claim 6 wherein said tether segments are arranged radially about said axis of radial symmetry of said bag panel.
8. The bag panel of Claim 6 wherein said axis of radial symmetry passes through the center of said central attachment region.
- 10 9. The bag panel of Claim 6 wherein said central attachment region associated with said bag panel contains a reinforcement.
- 15 10. The bag panel of Claim 9 wherein said reinforcement is attached to said tether segments.
11. The bag panel of Claim 6 wherein said tether segments are substantially rectangular in shape.
- 20 12. The bag panel of Claim 11 wherein said tether segments are substantially congruent.
13. The bag panel of Claim 6 wherein said bag panel is comprised of three of said tether segments.
- 25 14. The bag panel of Claim 13 wherein said bag panel is comprised of three tether segments and at least one reinforcement attached to said tether segments.

15. The bag panel of Claim 6 wherein said bag panel is comprised of four of said tether segments.
- 5 16. The bag panel of Claim 15 wherein said bag panel is comprised of four tether segments and at least one reinforcement attached to said tether segments.
- 10 17. An air bag, said air bag having at least one tether panel, said tether panel comprising at least two tether segments cut from a textile fabric, said fabric constructed of a group of warp yarns and a group of fill yarns, wherein each of said segments is cut in substantial alignment with one of said groups of yarns.
- 15 18. The air bag of Claim 17, said air bag having an axis of radial symmetry and being comprised of a first bag panel and a second bag panel, said axis of radial symmetry being located within a central attachment region of said first bag panel and said second bag panel, said first and second bag panels further having at least two tether segments arranged radially about said central attachment region in a configuration having at least one axis of symmetry that is perpendicular to said axis of radial symmetry of said bag panel, wherein said tether segments connect said first bag panel to said second bag panel and wherein said tether segments are cut from a textile fabric in alignment with the primary load-bearing axis of the fabric.
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- 25 19. A fabric blank comprising a textile fabric, said textile fabric constructed of a group of warp yarns and a group of fill yarns, on which a pattern-wise configuration of air bag panels, tether segments, and reinforcements is arranged in tiled relation,

said tether segments being cut in substantial alignment with one of said groups of yarns.

5 20. The fabric blank of Claim 19 wherein said tether segments are substantially rectangular in shape and are congruent.

21. The fabric blank of Claim 19 wherein said reinforcements are substantially circular in shape.

10 22. The fabric blank of Claim 19 wherein said textile fabric is coated.

23. The fabric blank of Claim 19 wherein said textile fabric is laminated.